

LISTING OF THE CLAIMS

Claims 1 to 17 (canceled).

18 (new): A treatment method for improving fatigue life of a metal material

comprising:

identifying a portion of a metal material for which fatigue may become a

problem;

performing pretreatment of said identified portion of the metal material;

after said performing pretreatment, performing ultrasonic impact treatment of

said identified portion of the metal material;

thereafter, performing a quality assurance test of said identified portion of the

metal material which has been subjected to said ultrasonic impact treatment;

thereby improving fatigue life of the metal material.

19 (new): A treatment method for improving fatigue life of a metal material

according to claim 18 wherein:

said identified portion of the metal material for which fatigue may be a

problem has been previously subjected to a process that alters internal stress and surface

stress of said identified portion of the metal material, said process comprising plastic

processing, deformation correction, heat treatment or welding; and

after performing said ultrasonic impact treatment of said identified portion of

the metal material, no process that alters internal stress and surface stress is performed on

said identified portion of the metal material and portions of the metal material neighboring

said identified portion.

20 (new): A treatment method for improving fatigue life of a metal material

according to claim 18 wherein:

said identified portion of the metal material for which fatigue may be a problem has been previously subjected to a process that alters internal stress and surface stress of said identified portion of the metal material, said process comprising plastic processing, deformation correction, heat treatment or welding;

said pretreatment includes performing a non-destructive test of said identified portion of the metal material; and

after performing ultrasonic impact treatment of said identified portion of the metal material, no process that alters internal stress and surface stress is performed on said identified portion of the metal material and portions of the metal material neighboring said identified portion.

21 (new): A treatment method for improving fatigue life of a metal material according to claim 18 wherein:

said pretreatment includes performing a crack inspection test of said identified portion of the metal material, said crack inspection test comprising visual inspection, liquid penetration examination, magnetic particle examination or eddy current examination.

22 (new): A treatment method for improving fatigue life of a metal material according to claim 21 wherein:

said performing the crack inspection test detects a crack in said identified portion of the metal material, and

removing said crack by grinding or gouging prior to said performing ultrasonic impact treatment.

23 (new): A treatment method for improving fatigue life of a metal material according to claim 22 wherein:

said removing said crack removes metal in a crack location to a depth of 5 mm or more;

after removing metal in said crack location, performing build-up welding at said crack location;

after build-up welding, providing a finished flat and smooth surface by grinding the build-up welding at the crack location; and thereafter,

performing visual inspection, liquid penetration examination, magnetic particle inspection or eddy current examination at the crack location for confirming no crack can be detected.

24 (new): A treatment method for improving fatigue life of a metal material according to claim 18 wherein:

said identified portion of the metal material for which fatigue may be a problem is a welding including a toe portion, a HAZ portion and a weld metal portion;

said ultrasonic impact treatment is performed on said welding including the toe portion, the HAZ portion and the weld metal portion in order to deform the welding shape so that stress concentration is unlikely to occur and to introduce compressive residual stress to render harmless fatigue crack generation minute defects and thereby suppress generation of cracks.

25 (new): A treatment method for improving fatigue life of a metal material according to claim 18 wherein:

said identified portion of the metal material for which fatigue may be a problem is a cut section produced by cutting the metal material with a saw, shearing, gas, laser or plasma;

said ultrasonic impact treatment is performed on said cut section and its vicinity to deform the cut section shape so that stress concentration is unlikely to occur and to introduce compressive residual stress to render harmless fatigue generation minute defects and hardened portions and thereby suppress generation of cracks.

26 (new): A treatment method for improving fatigue life of a metal material according to claim 18 wherein:

said ultrasonic impact treatment introduces compressive residual stress on cracks below a detection limit of a non-destructive test in order to suppress generation of cracks.

27 (new): A treatment method for improving fatigue life of a metal material according to claim 18 wherein:

said ultrasonic impact treatment comprises performing two or more passes of ultrasonic impact treatment at the same location of said identified portion of the metal material to introduce compressive residual stress below a detection limit of a non-destructive test in order to suppress generation of cracks.

28 (new): A treatment method for improving fatigue life of a metal material according to claim 18 wherein:

after performing said ultrasonic impact treatment, said quality assurance test is performed by replicating a surface of said identified portion using form replicating material or by scanning with a high precision measuring instrument to confirm that the surface of said identified portion treated by ultrasonic impact treatment has a depth of plastic deformation of not less than 0.05 mm thereby confirming introduction of compressive residual stress and improvement of fatigue life.

29 (new): A treatment method for improving fatigue life of a metal material according to claim 18 wherein:

said ultrasonic impact treatment is performed by an ultrasonic impact treatment apparatus located in a stationary process; and

said quality assurance test is performed by:

visually checking a tool tip of an ultrasonic tool located in the ultrasonic impact treatment apparatus;

visually checking an output setting of the ultrasonic impact treating apparatus;

visually checking generation of plastic deformation in said identified portion of the metal material;

thereby confirming introduction of compressive residual stress and improvement of fatigue life.

30 (new): A treatment method for improving fatigue life of a metal material according to claim 18 wherein:

said quality assurance test comprises:

using SUMP method to replicate said identified portion of the metal material surface treated by performing said ultrasonic impact treatment confirming that microstructure of said surface is finer than microstructure of an untreated surface and confirming deformation has been formed by said ultrasonic impact treatment.

31 (new): A treatment method for improving fatigue life of a metal material according to claim 18 wherein:

said quality assurance test comprises:

measuring grain size at a topmost surface of said identified portion of the metal material treated by performing said ultrasonic impact treatment by using an ultrasonic

grain size measuring apparatus to confirm deformation has been formed by said ultrasonic impact treatment.

32 (new): A treatment method for improving fatigue life of a metal material according to claim 18 wherein:

said quality assurance test comprises:

using a surface roughness meter or a laser displacement meter to measure roughness of a surface of said identified portion of the metal material treated by performing said ultrasonic impact treatment and confirming said surface of said identified portion is smoother in a direction perpendicular to a formed curve on the surface of the identified portion than an untreated surface of said metal material to confirm deformation has been formed by said ultrasonic impact treatment.

33 (new): A treatment method for improving fatigue life of a metal material according to claim 18 wherein:

said quality assurance test comprises:

measuring hardness of a surface of said identified portion of the metal material treated by performing said ultrasonic impact treatment confirming that surface hardness of the surface of said identified portion of the metal material is higher by not less than 20% and less than 100% than a surface of a portion of the metal material untreated by said ultrasonic impact treatment thereby confirming deformation of the surface of said identified portion of the metal material has been formed by said ultrasonic impact treatment.

34 (new): A treatment method for improving fatigue life of a metal material according to claim 18 wherein:

said quality assurance test further comprises:

applying a paint containing mirco-capsules to a surface of said identified portion of the metal material treated by said ultrasonic impact treatment and which has passed the quality assurance test;

whereby, subsequent generation of a crack in the surface of said identified portion of the metal material breaks said said micro-capsules contained in the applied paint at the subsequent generated crack location, wherein a paint of different color oozes out of said broken micro-capsules, thus visually identifying said subsequent generated crack.

35 (new): A metal material that has been treated using a treatment method for improving fatigue life according to any one of claims 18 to 34.